Atty. Docket: 03-0489

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

James A. DiLellio : Group Art Unit: 3662

Serial No.: 10/605,890 : Examiner: Issing, G.C.

Filed: November 4, 2003

Title: GPS NAVIGATION SYSTEM WITH INTEGRITY AND RELIABILITY MONITORING CHANNELS

Hon. Commissioner for Patents
Alexandria, VA 22313-1450

RULE 132 DECLARATION

Sir:

I, JAMES A. DILELLIO, make the following declaration, pursuant to 37 CFR § 1.132, in opposition to the obviousness rejection set forth in ¶¶ 4-9 of the non-final action mailed on July 27, 2007 in the above-referenced patent application.

I am an employee of the assignee, The Boeing Company, and am the sole inventor of the inventions recited in the pending claims of the above-referenced patent application.

In ¶ 4 of the office action, claims 39-47 were rejected under 35 U.S.C. § 103(a) as being unpatentable over either Hegarty or Stein in view of Benedicto and Hollreiser. I disagree with the grounds of rejection for the following reasons.

Interpretation of References

A GPS integrity augmentation system provides two primary functions to ensure that the GPS User's position reported by his/her receiver is not misleading or "unsafe". To this end, current systems such as WAAS, EGNOS, and MSAS have been developed, and are based on the Hegarty guidelines.

The Hegarty reference states (at page 457):

> The GIC [GPS Integrity Channel] uses a ground network to identify any faults in satellite ranging signals, and then broadcast warnings to all users. . . .
>
> First, the integrity data will contain "use/don't use" flags to identify erratic or untrustworthy satellites. Second, the integrity data will contain coarse estimates of the pseudorange error size.

The description in the Stein reference for a GIC follows the same basic design approach and implementation as Hegarty.

Thus, GPS integrity from the GIC defined previously is provided through two important functions: (1) rapid alerting of untrustworthy satellites; and (2) estimates of pseudorange size or pseudorange corrections. For Hegarty's GIC, both of these functions are based on a high-speed, low-latency ground network that monitors the estimates of pseudorange correction size in real-time against a ground surveyed truth, and routes corrections and alerts using the geostationary satellite overlay

signals. In the case of WAAS and other space-based augmentation systems (SBAS), the estimates of pseudorange correction size are also based on the ability of the regional augmentation's monitoring network to generate and distribute differential corrections regionally to the SBAS users. For GPS and the planned GALILEO system that have a global monitoring network and satellites with global coverage, the 2nd limitation does not exist.

Implementing a GIC, as proposed, creates several challenges and limitations. First, it requires a high-reliability real-time communications network to route GPS monitored data from the each SBAS monitoring site to a control and uplink site. It also requires real-time calculation of function (1) identified above, so that errors can be quickly disseminated to users. For category 1 precision approach aircraft, the "time to alert" (TTA) allocated to the ground, control and uplink to the SBAS satellite is 5.2 seconds, with the remaining 0.8 second being allocated to the receiver to receive, demodulate and alert the user of the untrustworthy satellite (or untrustworthy position solution). Higher-integrity aircraft approach categories, as well as evolving auto-drive systems for commercial and retail automotive applications, drive the TTA to 1-2 seconds. Meeting the 5.2 second TTA is currently

satisfied with little margin from systems like WAAS, preventing it from ever evolving to providing higher-integrity services. In addition, the need for high-reliability ground monitoring network implies that any interruptions that last more about 1-2 seconds from the communication network routing the data from the monitoring sites, or satellite uplinks to SBAS satellites will interrupt service and reduce system availability. The GIC approach also leads the systems to triple voting schemes to evaluate monitoring site failures, adding complexity and cost to the system implementation, operation, and maintenance. Lastly, SBAS monitoring sites that are in the remote locations often rely on SATCOM communication networks. Under this architecture, the system can experience problems meeting the overall 5.2 second alert requirement due to modulation, demodulation, error correction and speed-of-light delays to and from SATCOM satellites.

How These References Differ from Instant Invention

The integrity information incorporating the "use/don't use" flags are generated internally (i.e., within the navigation receiver) by the instant invention, thereby supporting TTAs of 1-2 seconds. In contrast, the GIC generates these flags external to the receiver. In both cases of the instant invention and the prior art references, estimates of pseudorange accuracy are

provided externally. In the instant invention, the integrity information is already generated as part of a proposed GPS modernization with a new message type called the URA (user range accuracy) message (see claim 39, part d). The integrity signals are essentially a bound on clock and ephemeris error within the GPS signals (see ¶ 0033).

The ground monitoring proposed by the instant patent application also generates monitoring bits representing the health of each of the satellites (see claim 39, part d). Note that this information is NEVER transmitted to the user, but instead alters the integrity signals appropriately (see claim 41). The monitoring bits represent whether the ground station believes the aforementioned errors are bounded (see ¶¶ 0037 and 0049). This feature does not appear in any of the references cited by the examiner.

The approach adopted in the instant patent application differs from Benedicto (see p. 13), where Benedicto is interpreted as a "fall back" to RAIM (Receiver Autonomous Integrity Monitoring), which is consistent with currently certified SBAS receivers that follow RTCA DO-229C MOPS. Benedicto is quoted as follows (see page 13):

> It is planned to provide integrity by broadcasting integrity alerts to the users. These alerts will indicate when the GALILEO

> signals are outside specification. The user receiver can then reject signals from satellite to which an alert refers or, using the outputs of the receiver signal processing in conjunction with other receiver techniques, such as RAIM, reduce the influence that these signals have on the final computed position.

Hollreiser's receiver architecture, described on page 1920, appears to follow a similar approach.

To illustrate the difference between the instant invention and RAIM, RAIM FD (fault detection) and FDE (fault detection and exclusion) per RTCA DO-229C does not use any *a priori* information about the GPS signals. Instead, it assumes a constant level of signal noise based on a root sum square (RSS) of the User Equivalent Range Error (UERE) sources. In other words, the RAIM receiver is preloaded with a static pseudorange error.

As disclosed in the instant patent application (see ¶ 0032):

> Unlike traditional integrity monitoring software, the monitoring software 32 incorporates integrity information received from the satellites 12 in addition to an internal self consistency check for fault detection and exclusion.

This feature of the navigation receiver is not disclosed in any reference cited by the examiner. The fault detection and exclusion function that incorporates integrity information at

the receiver provides the same functionality as the GIC "use/don't use" flag generated at the GIC control center, but can do so within 1 to 2 seconds (versus the 5.2 seconds supported by the GIC).

This is further supported by the following statements in the instant patent application:

> [0058] In step 124, the receiver 16 determines the integrity of the determined range and position of each satellite 12 in response to the integrity signals 46. The controller 30 utilizes the integrity software 32 to perform the self-consistency check. In performing the self-consistency check, the controller 30 monitors the GPS signals 13 that are within range and utilizes the information contained with the integrity signals. . . .
>
> [0059] In step 126, the receiver 16 determines reliability of the position information in response to the integrity signals 46. The integrity software 32 is used when monitoring the integrity signals 46 to determine reliability thereof. . . .

In summary, the cited references neither disclose nor suggest a methodology involving the following: the transmission of URA monitoring bits indicating the health of satellites from ground to satellites; the transmission of updated GPS signals from said satellites wherein the updated GPS signals take into account those URA monitoring bits; the determination, at the receiver, of the range and position of each satellite based on the updated GPS

signals received from the satellites; and the determination, at the receiver, of the integrity of the determined position of each satellite as a function of integrity signals included in the updated GPS signals.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor: James A. DiLellio

Inventor's signature: ______________________ ______________
DATE

CERTIFICATE OF MAILING

The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date set forth below.

January 25, 2008
Date

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Dennis M. Flaherty

signals received from the satellites; and the determination, at the receiver, of the integrity of the determined position of each satellite as a function of integrity signals included in the updated GPS signals.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor: James A. DiLellio

Inventor's signature: ____________ 25-Jan-2008.
DATE

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